in this case. Claims 1-17, 21-26 and 39-44 have been rejected. Claims 18-20 and 27 have been objected to. Claims 4, 18 and 27 have now been amended. New claim 45 has been added.

OBJECTED CLAIMS

Applicant has chosen to amend claim 18 to form an independent claim including the limitations of all intervening claims (dependent claims 13, 15, 16 and base claim 1). Applicant has chosen to amend claim 27 to form an independent claim including the limitations of all intervening claims (dependent claims 13, 15, 23 and base claim 1).

Rejections over 35 USC 112

The Examiner has rejected claims 4 and 43 over 35 USC 112, second paragraph, as being unclear. Applicant respectfully traverses the rejections of the Examiner.

With regard to claim 43, Applicant notes that the phrase in question, "said endoscopic cable", is actually "said endoscope cable", and that furthermore, the term "endoscope cable" is first recited in claim 41; claim 43 depends from claim 42, which in turn depends from claim 41. Therefore, Applicant feels that the antecedent basis is clear for claim 43.

With regard to claim 4, Applicant has chosen to amend claim 4 to overcome the rejections of the Examiner and to advance the prosecution. Amended claim 4 now depends from claim 2, and not from claim 1 as previously recited.

Applicant feels that these arguments and amendment overcome the rejections with regard to claims 4 and 43, and places these claims in condition for allowance.

Rejections over 35 USC 103(a)

The Examiner has rejected claims 1-6, 11-17, 21, 23-25, 39-40 and 44 under 35 USC 103 as being unpatentable over US Patent No. 5,769,640 to Jacobus et al. (Jacobus) in view of US Patent No. 5,882,206 to Gillio (Gillio). The rejections of the Examiner are respectfully traversed.

Applicant feels that certain issues remain unclear, which were previously addressed in the first office action by the Examiner and which were therefore also addressed in the first response of Applicant.

In particular, Applicant feels that one important aspect of the present invention, which is clearly recited in the claims, is that the present invention relies upon a three-dimensional mathematical model of the simulated organ for determining the visual feedback that is provided. The mathematical model of the present invention is divided into a plurality of segments that are arranged in a linear sequence.

The Examiner has stated that Jacobus also includes such a model, described at column 5, lines 20-35, and at column 7, lines 4-14. However, column 5, lines 20-35 only describes a well known in the art process for rendering graphics. First, lines 20-27 describe a process for merging two existing images; the image capture process itself is described in column 4, lines 30-35, and clearly indicates that these images are obtained from actual medical procedures, and are not simulated *de novo*. Already, this is sufficient to differentiate the present invention from Jacobus, as claim 1 clearly recites that simulated images are used, while Jacobus uses actual images from actual medical procedures.

Lines 28-31 of column 5 describe a "3D graphics generator" which generates three dimensional images of *endoscopic instruments*. Therefore, this generator only

produces images of the instruments themselves, and does not provide any other image generator or simulation. Again, the 3D graphics generator does not rely upon a three-dimensional mathematical model of a simulated organ, because the generator is only concerned with images of the instruments.

Lines 32-35 of column 5 describe a "graphics overlay unit" for overlaying the three dimensional images of the endoscopic instruments onto the "morphed video derived imagery", which are the combined actual images from video data. Again, no mention is made of the three-dimensional mathematical model of the simulated organ.

Column 7, lines 4-14 describe a geometric model of an organ which is only used for determining appropriate forces and torques, and not for determining visual feedback. Furthermore, the geometric model is not comprised of segments, and certainly does not feature segments arranged in a linear sequence.

Applicant also wishes to respectfully traverse the assertion of the Examiner that the arrangement of segments in a linear sequence is an inherent feature of the present invention; even though *movement of a medical instrument* can only be linear, the model itself has no such *inherent* requirement of linearity. The lack of an inherent requirement for linearity is even more true for the geometric model of Jacobus, which is only intended for providing force feedback. Also, the geometric model of Jacobus is not composed of a plurality of segments, in any case.

The Examiner has stated that Gillio teaches three-dimensional models as being known in the background art, specifically at column 1, lines 39-41. However, the three-dimensional models described therein are volumetric models, and are therefore quite different from the model of the present invention, which comprises a plurality of segments in a linear sequence. In particular, the volumetric models described are useful for a working simulation of an entire organ, while the present invention

provides a three-dimensional model of an organ which is useful for the process of learning how to perform a medical procedure. Therefore, the present invention provides realistic simulated images for learning purposes, but does not seek to simulate the organ in order to provide a working model of an entire organ. By contrast, Gillio requires that the organ be simulated as a full working model, for the purposes of surgery, as Gillio states in the abstract that the taught invention may also be used a remote or telesurgery device for performing actual surgeries through remote means.

Another important aspect of the present invention concerns the use of polygons and splines for the model of the simulated organ of the present invention. Dependent claim 40 of the present application recites the use of polygons defined with respect to a spline. The Examiner has stated that column 5, lines 24-31 of Jacobus teach a mathematical model that features a plurality of polygons constructed according to a spline. Applicant respectfully traverses this rejection by noting that as previously described, this portion of Jacobus does not describe a mathematical model. Also, this portion of Jacobus never mentions a spline. Finally, although the word "polygon" is mentioned, it is described as being used in a regular image process which is well known in the art. By contrast, the present invention uses polygons defined with regard to a spline. This use was never taught nor described in the prior art. In order to further emphasize this point, Applicant has chosen to add new independent claim 45, which combines the limitations of claims 1 and 40.

The Examiner has also rejected claims 7-9 under 35 USC 103 as being unpatentable over Jacobus in view of Gillio and further in view of US Patent No.

5,956,040 to Asano et al (Asano). The rejections of the Examiner are respectfully traversed.

The objects of Jacobus and Gillio are as described above.

The object of Asano is a basic graphic algorithm for graphic rendering. The section quoted by the Examiner, col 4 lines 21-41, describes the use of an algorithm which manipulates arrays of linked objects in response to local "pulling" or "pushing" of neighboring objects. Asano does not teach or describe the use of such an algorithm for modeling an organ, as the teachings of Asano are restricted to graphic rendering.

Furthermore, as noted above, claims 7-9 recite the use of a spline and/or polygons defined with respect to a spline. The Examiner has stated that column 5, lines 24-31 of Jacobus teaches a mathematical model that features a plurality of polygons constructed according to a spline. Applicant respectfully traverses this rejection by noting that as previously described, this portion of Jacobus does not describe a mathematical model. Also, this portion of Jacobus never mentions a spline. Finally, although the word "polygon" is mentioned, it is described as being used in a regular image process which is well known in the art. Also as described above, Gillio teaches the use of volumetric models which are different from the model of the present invention. Therefore combining Jacobus, Gillio and Asano would not result in the use of splines for modeling, for example for local deformation, and/or the combination of the use of splines and polygons for such local deformation.

By contrast, the present invention uses splines and/or polygons defined with regard to a spline. This use was never taught nor described in the prior art.

The Examiner has also rejected claim 22 under 35 USC 103 as being unpatentable over Jacobus in view of Gillio and further in view of US Patent No. 5,767,839 to Rosenberg. The rejections of the Examiner are respectfully traversed.

Applicant feels that since claim 22 depends from claim 16, which was shown to be allowable as described above, claim 22 is also allowable as depending from an allowable claim.

The Examiner has also rejected claims 26 and 40-42 under 35 USC 103 as being unpatentable over Jacobus in view of Gillio and further in view of US Patent No. 6,071,233 to Ishikawa et al (Ishikawa). The rejections of the Examiner are respectfully traversed.

The objects of Jacobus and Gillio are as described above.

The object of Ishikawa is an actual endoscope for use on an actual medical procedure on an actual patient. Therefore, Ishikawa does not mention simulation at all, nor does Ishikawa teach or suggest the use of model of a simulated organ.

By contrast, the present invention clearly requires a simulated organ which is modeled according to a mathematical model. As described above, none of these three references, alone or in combination, teaches a simulated organ which is modeled according to a mathematical model. This difference is important because the present invention does not seek to mimic or copy reality, but rather seeks to provide a model which can be used to simulate an organ. Thus, attempting to combine teachings from an actual endoscope or procedure, with a simulated medical procedure, would clearly be inoperative.

From the above remarks and amendments, Applicant feels that claims 1-27 and 39-45 are now in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Applicant had originally wished to discuss these issues in an Interview with the Examiner, which unfortunately was not possible at this time because the file wrapper was unavailable; however Applicant still wishes to have such an Interview in the future if possible. The undersigned may be contacted at dvorah@ipatent.co.il.

Respectfully submitted,

D'vorah Graeser
US Patent Agent
Reg. No. 40,000

Date: May 1, 2003

APPENDIX – marked-up claims

4. (Twice Amended) The system of claim [1] 2, wherein said texture mapping data includes images obtained from performing said actual medical procedure on said actual subject.

18. (Amended) [The system of claim 16,] A system for performing a simulated medical procedure, comprising:

(a) a simulated organ, wherein said simulated organ is a gastro-intestinal tract;

(b) a simulated instrument for performing the simulated medical procedure on said simulated organ, wherein said simulated instrument is an endoscope, said endoscope featuring a sensor for determining a location of said sensor in said gastro-intestinal tract;

(c) a locator for determining a location of said simulated instrument within said simulated organ;

(d) a visual display for displaying images according to said location of said simulated instrument within said simulated organ for providing visual feedback, such that said images simulate actual visual data received during an actual medical procedure as performed on an actual subject, said visual display including:

(i) a three-dimensional mathematical model for modeling said simulated organ according to a corresponding actual organ, said model being divided into a plurality of segments, said plurality of segments being arranged in a linear sequence;

(ii) a loader for selecting at least one of said plurality of segments from said linear sequence for display, said at least one of said plurality of segments being selected according to said location of said simulated instrument within said simulated organ;

(iii) a controller for selecting a simulated image from said segment according to said location of said simulated instrument; and

(iv) a displayer for displaying said simulated image;

(e) a computer for determining said visual feedback according to said location of said sensor; and

(f) a tactile feedback mechanism for providing simulated tactile feedback according to said location of said tip of said endoscope, wherein said tactile feedback mechanism is located in said endoscope, and said endoscope further comprises:

(i) a guiding sleeve connected to said tip of said endoscope;

(ii) at least one ball bearing attached to said guiding sleeve for rolling along an inner surface of said gastro-intestinal tract;

(iii) at least one linear motor attached to said guiding sleeve;

(iv) a piston operated by said linear motor, said piston contacting said inner surface of said gastro-intestinal tract; and

(v) a controller for controlling said linear motor, such that a position of said piston is determined by said controller, and such that said position of said piston provides said tactile feedback.

27. (Amended) [The system of claim 23,] A system for performing a simulated medical procedure, comprising:

(a) a simulated organ, wherein said simulated organ is a gastro-intestinal tract;

(b) a simulated instrument for performing the simulated medical procedure on said simulated organ, wherein said simulated instrument is an endoscope, said endoscope featuring a sensor for determining a location of said sensor in said gastro-intestinal tract;

(c) a locator for determining a location of said simulated instrument within said simulated organ;

(d) a visual display for displaying images according to said location of said simulated instrument within said simulated organ for providing visual feedback, such that said images simulate actual visual data received during an actual medical procedure as performed on an actual subject, said visual display including:

(i) a three-dimensional mathematical model for modeling said simulated organ according to a corresponding actual organ, said model being divided into a plurality of segments, said plurality of segments being arranged in a linear sequence;

(ii) a loader for selecting at least one of said plurality of segments from said linear sequence for display, said at least one of said plurality of segments being selected according to said location of said simulated instrument within said simulated organ;

(iii) a controller for selecting a simulated image from said segment according to said location of said simulated instrument; and

(iv) a displayer for displaying said simulated image; and

(e) a computer for determining said visual feedback according to said location of said sensor,

wherein said endoscope further features a handle for holding said endoscope and a tool unit, said tool unit comprising:

(i) a simulated forceps;

(ii) a channel for receiving said simulated forceps, said channel being located in said handle; and

(iii) a tool control unit for detecting a movement of said simulated forceps, said tool control unit being located in said channel and said tool control unit being in

communication with said computer, such that said computer determines said visual feedback and said tactile feedback according to said movement of said simulated forceps.